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Correction of the Lower Third of the Face and Submental Area in Various Types of Aging with Laser-Assisted Liposuction

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Abstract

Age-related changes in the face - at all times were not a desirable phenomenon in socially active and successful people. In modern society, success is primarily identified with an attractive appearance and a healthy lifestyle. Healthy lifestyle is actively promoted in mass media, this message has many followers all over the world. The most striking manifestations of age-related changes are concentrated in the lower third of the face and submental area, which is manifested in violation of the contours of the jaw line, as well as in the smoothing of the cervical - chin angle. In some genetic features, such as micrognathia, these changes lead to the visual perception of the face less young than it actually is, even without obvious manifestations in other areas of the face. We have developed and put into practice a minimally invasive method for correcting the lower third of the face and the submental area, using laser-assisted liposuction, with various degrees of age-related changes. Which allows you to effectively deal with this problem.

Keywords: rejuvenation, lower third of the face, laser - assisted liposuction, minimally invasive surgery

1. Introduction

The fat accumulation in sub-mental area is a problem at the forefront of many minds, since excess adipose tissue leads to the drooping of lower face and causes further ptosis. These changes affect a full esthetic perception of the face, since a clear oval shape of the face is associated with young age and the smoothing of lines and corners with old age [1].

Plastic surgery offers a variety of ways to solve this problem, among which are different variations of platysmaplasty, combined lifts in combination with liposuction and other. However, all of them are tempered by significant stress of an invasive procedure, a long rehabilitation period, providing anesthetic procedures and a high risk of complications [2].

The realities of modern life and modern lifestyle determine that when choosing an operative measure most patients want a light invasion, a short rehabilitation period and no general anesthesia [3].

We use laser-assisted liposuction to correct the excess fat accumulation in sub-mental area and at the lower face as well as to correct age-related alterations [4].

Many studies conducted by various authors on the effects of laser emission in tissues have shown that lipolysis was followed by small blood vessels coagulation in adipose tissue, cell lysis (bursting), reorganization of the reticular dermis and collagen coagulation in adipose tissue. Histological tests have demonstrated some of the advantages of using the Nd: YAG laser. These include formation of new collagen, reduction of intraoperative and postoperative hemorrhage as well as a reduction of adipocyte quantity [3–6].

Furthermore, a dermal flap retracts after laser, which in turn allows for reaching the lifting effect. In 2002 Badin published an article entitled “Laser Lipolysis: skin flaccidity under control”, in which he demonstrated histological changes of tissue after laser treatment. During the operation of a laser, adipocyte membranes break down, blood vessels coagulate and collagen fiber restructures [7].

The research demonstrated that laser lipolysis with selective exposure to ND: YAG laser radiation with a wavelength of 1064 nm is less traumatic and is accompanied by tissue reactions, which appear by neocollagenesis and reduction of the dermal flap. In order to maximize the impact and minimize the negative consequences of laser, Badin recommended temperature control of the skin integument in the surgical area, range of safe temperatures is between 38–41°C [7]. The laser lipolysis allows performing a surgery on the so-called hazardous areas, which include lower legs, arms, face [3, 8].

Thus, the development of algorithms for using laser-assisted liposuction in hazardous areas such as the lower face and the submental area continues to hold its relevance for greater effectiveness and minimum complications from this surgery.

2. Materials and methods

In the period from August 2011 to August 2019, we performed 570 surgeries using the laser-assisted liposuction method with the FotonsDinamic SP, Nd: YAG laser, 1064 nm wavelength.

The age of patients ranged between 28 and 70 years, the average age – (40 ± 5) years (**Figure 1**).

The choice of laser power as well as the number of accesses depends on the manifestation degree of signs of aging.

In our practice, we use the Baker's classification of deforming ptosis of soft tissues (**Figure 2**) [1], in which he categorizes IV types of patients:

- I. Patients below the age of 40. Initial indications of aging, a small amount of body fat in the submental area. Skin elasticity and tone are normal.
- II. Patients between 40 and 50 years of age. Mild ptosis of the tissues of the lower face, more expressed fat deposits in the submental area, a decrease of neck skin tone, platysmal bands are not expressed.
- III. Patients between 50 and 60 years of age. Pronounced ptosis of the soft tissues of the lower face and fat deposits in the submental area. Moderate weakness of the neck skin and platysmal bands in dynamics.
- IV. Patients between 50 and 60 years of age. Pronounced ptosis of the soft tissues of the lower face, significantly reduced tissue tension of the neck skin. Active platysmal bands are visible at rest.

Before the surgery all patients underwent comprehensive examinations, which included: medical histories, contraindications or indications to surgery, laboratory

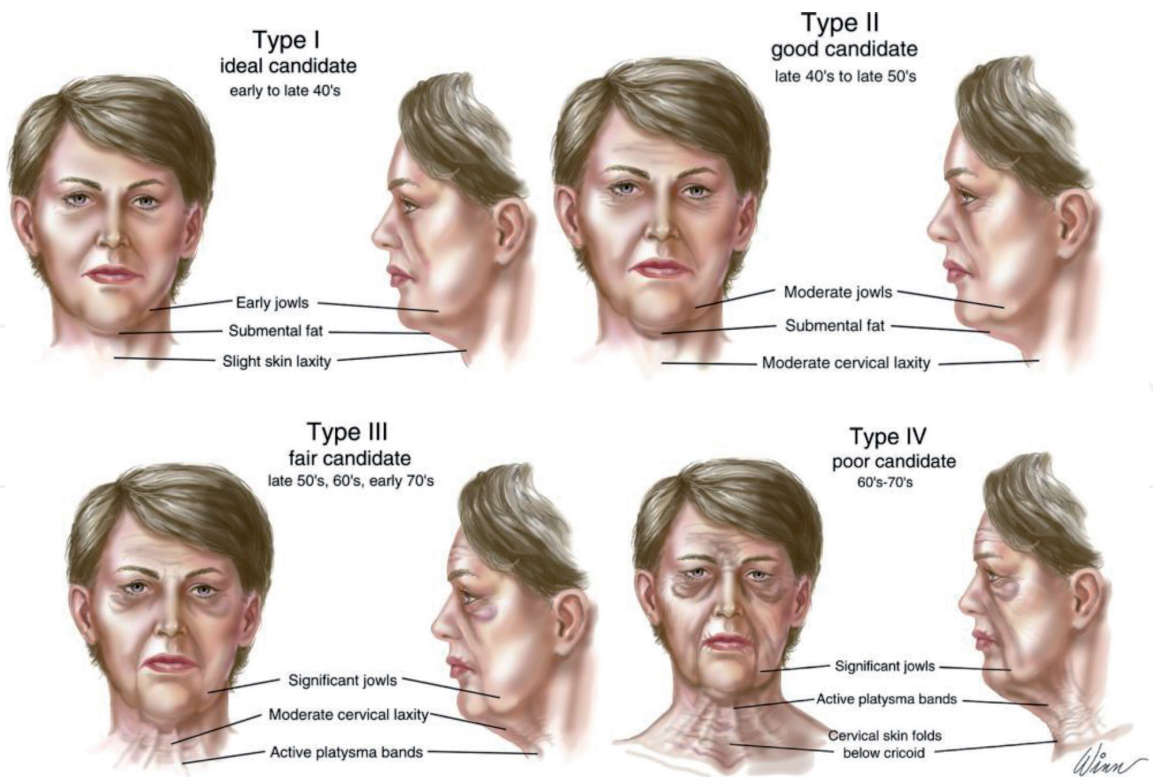


Figure 1.
Dividing patients into treatment groups based on types according to the Baker's classification: Group I-100, group II-170, and group III-260.

Dividing patients based on the type of ptosis



Figure 2.
Classification of deforming ptosis of soft tissues by Daniel C. Baker.

tests (biochemical and clinical blood analysis, blood group determination and Rhesus factor determination, HIV antibody test, blood testing for hepatitis); taking an electrocardiogram, as well as an examination by a therapist [9].

The operation protocol can be divided into several stages:

1. Photomacrography.
2. Anesthesia.
3. Setting up a certain laser program.
4. Laser-assisted liposuction.

It the first stage of macrophotography the surgery area was marked (in a vertical position) with the identification of the type of age-related changes and access options. Photography was made in five projections-full face, profile and at an angle of 45° on each side. When photographing, the horizontal position of the Frankfurt line was observed. (**Figure 3**) [10, 11].

All surgical interventions were performed under local anesthesia in accordance with the operative areas, their localization, the volume of removed fat, and the marking. To do this, a tumescent solution was prepared, for which 50.0 1% lidocaine hydrochloride solution, 1.0 epinephrine, 12.5 8.4% sodium bicarbonate solution and up to 1000.0 ml of saline solution in the form of 0.9% NaCl aqueous solution were mixed. Skin punctures and injection of a tumescent solution into subcutaneous fat were performed using standard syringes along the contour lines of the operative area. They saturated the entire volume of subcutaneous fat to



Figure 3.
Photomacrography of patients before and after the surgery.

create local intracellular hyperhydration of lipocytes. The ratio of the volume of the tumescent solution injected into subcutaneous fat for its infiltration and the volume of subcutaneous fat to be liposucted was chosen as 1:2 [12].

The next stage was to set the laser parameters, which varied depending on the treatment area and the thickness of subcutaneous fat, as well as the severity of age-related changes.

Stage 1 - a slight decrease in the elasticity of the neck skin, a mild double chin, the contour of the lower jaw is not changed. One puncture was made in the submental fold of no more than 2 mm. in this case. The area under the chin was treated with the subsequent removal of fat and heating of the skin in the lower jaw area. Working conditions: power no more than 12 W, the total power consumption was up to 3000 J.

Stage 2 - moderate reduction in the elasticity of the neck skin, changes in the contour of the lower jaw, the formation of the double chin. In this case, the fat was removed both in the under-chin area and in the lower jaw area. With this degree of age-related changes, the parameters were changed to increase the power of 14 W; the total power consumption was up to 4000 J.

Stage 3 - moderate decrease in the elasticity of the neck skin, pronounced changes in the contour of the lower jaw, decreased platysma tone. With this degree of age-related changes, not only subcutaneous fat was removed under the chin area, in the lower jaw area, but also sub-platysmal fat was removed. In addition, the heating of the platysma was carried out to the level of the rannular cartilage. Working conditions: power 15 W, the total power consumption was up to 5000 J.

Stage 4 - flabby, atonic skin of the neck with deep circular wrinkles, significant changes in the contour of the lower jaw, double chin, severe platysmal bands. If there was evidence of aging, all supra- and sub-platysmal fat was removed in the lower jaw area, under the chin and neck to the jugular notch. Additional accesses were made at the corners of the lower jaw. Additional heating of platysma and the upper layers of the skin was conducted. Working conditions: power 16 W, the total power consumption was about 7000 J.

The next stage was lipoaspiration, 10–15 minutes after the beginning of infiltration of subcutaneous fat with a tumescent solution. The puncture in the area of the chin fold was expanded to 3 mm with a blunt dilator and an infiltration cannula was introduced into the widened puncture. By reciprocating movement of the infiltration cannula throughout the volume of the removed subcutaneous fat, infiltration tunnels were formed, while they were placed close to each other in the form of a fan-shaped network, with an approach to the submental area and the front surface of the lower jaw.

Then an optical cannula of a laser device with a diameter of 1 mm and a fiber-optic light carrier in it with the 600 micron thickness of the optic fiber was inserted into the infiltrated subcutaneous fat tissue through a puncture. Fat cells were treated with Nd:YAG laser radiation with a wavelength of 1064 nm. After performing the laser treatment, the optical cannula was extracted from the puncture and the resulting fat detritus of emulsified adipocytes was sucked out of the liposuction area by means of an aspiration cannula using a negative pressure of 0.2–0.3 Bar. After removal of fat detritus emulsified adipocytes from the liposuction area, the dermis was heated to 39–40°C by means of the same optical cannula with a fiber-optic light carrier in it.

At the end of the surgery, a suture with a nonabsorbable propylene thread Prolene 6–0 and an aseptic bandage were applied to the puncture site, and a compression bandage was applied to the neck and chin area.

Procedures for postoperative care were “standard” for all patients: dressings using alcohol chlorhexidine and water-soluble ointments. At the same time, for

7 days after the surgery antibiotic treatment was prescribed with broad-spectrum antibiotics and nonsteroidal anti-inflammatory drugs. The first 7 days after surgery the patient used a compressive dressing round the clock and following 21 days – only at night.

All patients followed a number of recommendations after the procedure:

1. Avoid heavy physical activity for one week;
2. From the second day after the surgery, patients were prescribed a course of physiotherapy: irritative current therapy No.5, from the 6th day patients received ultrasonics with hydrocortisone No. 10;
3. From the 8–12 days a course of 10–12 procedures of manual lymphatic drainage or mechanical massage (LPG, Icoon);
4. control examinations after 3, 6, 12, 24, 36, 48 months.

Contraindications to laser-assisted liposuction are diabetes mellitus, coagulopathy, connective tissue diseases, etc.

As in any surgical practice with laser-assisted liposuction, there is a risk of complications. In his article, Blum described the most common complications: the appearance of bumps on the skin (0.17%) and prolonged edema (0.09%) [13].

Kutz described specific complications in the form of burns and skin infections, which occurred in 0.93% of cases [14]. Among the possible complications, the formation of hematomas and seromas is also named [15]. In case of aggressive treatment, the formation of retractions and scars is possible. Rare cases of fatal accidents of developing the pulmonary embolism have been described, but with laser-assisted liposuction of the lower limbs [16].

3. Results

Example 1. Patient O., female, 35 years old, came into our clinic complaining of local excess subcutaneous fat in the chin area, smoothed neck-chin corner. Local status: slight decrease in elasticity of the neck skin, slight local excess of subcutaneous fat in the chin area and a smoothed neck-chin corner, the contours of the lower jaw are not changed. Age-related changes of the face and neck according to the Baker's classification type 1. Lipolytic injections and machine cosmetology have failed to produce the expected results.

Based on the examination results, it was decided that the submental area will become the liposuction area constituting the surgical field. In accordance with this, the contour borders of the surgical field were defined and a single surgical access point was set in the submental fold. The contour lines of the surgical field and a given surgical access point were marked on the patient's body in a standing position. During infiltration anesthesia, 90 ml of a tumescent solution was injected. Fat cells were treated with Nd: YAG laser radiation with a wavelength of 1064 nm-12 W. The total power consumption amounted to 2500 J. At a single stage 35,0 of fat detritus was removed, while there was no damage to the surrounding areas, hemorrhage was minimal, and the rehabilitation period was reduced to 4 weeks. The achieved skin retraction gives a pronounced esthetic effect, which persists even one year after the surgery (**Figure 4**).

Example 2. Patient L., female, 44 years old, came into our clinic complaining on local excess subcutaneous fat in the submental area, smoothed neck-chin corner,

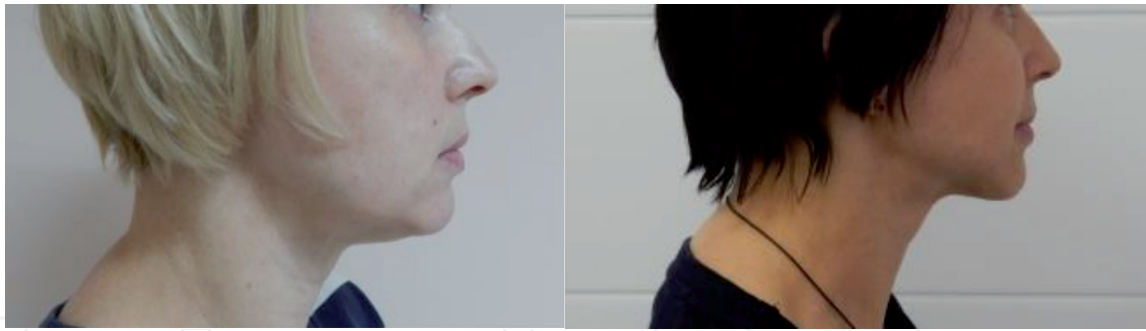


Figure 4.
Patient O., female, 35 years old, with age-related changes in the lower third of the face of type I according to the Baker's classification, before and 1 year after the surgery.



Figure 5.
Patient L., female, 44 years old, with age-related changes in the lower third of the face of type II according to the Baker's classification, before and 18 after the surgery.

ptosis of the lower third of the face. Local status: moderate decrease in elasticity of the neck skin, ptosis of the lower third of the face and pronounced change in the contour of the lower jaw, local excess of subcutaneous fat in the submental area associated with them. Age-related changes of the face and neck according to the Baker's classification type 2. She did not visit cosmetologists, and no therapy was carried out in this area.

Based on the examination results, it was decided that the submental area of the neck and the lower jaw will become the liposuction area constituting the surgical field. In accordance with this, the contour borders of the surgical field were defined and a single surgical access point was set in the submental fold. The contour lines of the surgical field and a given surgical access point were marked on the patient's body in a standing position. General clinical examination and tests were carried out. According to the planned scope of surgery, 110 ml of a tumescent solution was injected into the subcutaneous fat. Laser-assisted lipoaspiration was performed according to the protocol described above, based on the degree of soft tissue ptosis. Fat cells were destroyed by ND: YAG laser radiation with wavelength of 1064 nm-13 W. The total power consumption amounted to 3000 J. In addition to standard care after liposuction in the early postoperative period, the patient underwent physical therapy in the form of 12 ultrasound procedures with hydrocortisone. As a result of combined liposuction performed according to the said method, 50.0 of fat detritus was removed at a single stage. The patient was inspected 1.5 years after the surgery: the pronounced esthetic effect is preserved (**Figure 5**).

Example 3. Patient P., female, 49 years old, came to our clinic complaining on local excess subcutaneous fat in the chin area, smoothed neck-chin corner, and loose jowls. Local status: loose jowls, pronounced change in the contour of the lower

jaw, local excess of subcutaneous fat in the submental area, smoothed neck-chin corner, neck skin laxity and decreased platysma tone. Age-related changes of the face and neck according to the Baker's classification type 3. The lipolytic injections over the course of one year did not provide the required esthetic result.

Based on the examination results and diagnosis, it was decided that the submental area, the lower jaw area and the neck area from its submental area to the level of the jugular notch will become the liposuction area constituting the surgical field. In accordance with this the contour lines of the surgical field and surgical access points were defined – one in the submental fold and two at the corners of the inferior jaw, one point of surgery access on each side of the neck. General clinical examination and tests were carried out and according to the planned scope of suction-assisted fat removal; 170,0 of tumescent solution was injected. Fat cells were destroyed by ND: YAG laser radiation with wavelength of 1064 nm-14 W. The total power consumption amounted to 3500 J. Postoperative wound treatment and care in the postoperative period were carried out in a similar way as in the above cases. In the early postoperative period after liposuction, the patient underwent physical therapy in the form of 12 ultrasound procedures with hydrocortisone and 12 ultrasound procedures with a drug based on the collagenolytic protease complex “Fermencol gel”. As a result of combined liposuction performed according to the said method, 45.0 of fat detritus was removed at a single stage. The patient was inspected two years after the operation: the esthetic effect is preserved (**Figure 6**).

Example 4. Patient A., female, 58 years old, came to our clinic complaining on local excess subcutaneous fat in lower third of the face and neck area, loose jowls. Local status: loose jowls and pronounced change in the contour of the lower jaw associated with them, local excess of subcutaneous fat in the submental area and neck area, smoothed neck-chin corner, saggy neck skin with circular wrinkles, decreased platysma tone. Age-related changes of the face and neck according to the Baker's classification type 4. She did not visit cosmetologists and plastic surgeons.

Based on the examination results, it was decided that the submental area, the lower jaw area and the neck area from its submental area to the level of the jugular notch will become the liposuction area constituting the surgical field. In accordance with this, the contour lines of the surgical field and surgical access points were defined – one in the submental fold and two at the corners of the inferior jaw, one point of surgical access on each side. According to the planned scope of lipoaspiration, 180 ml of tumescent solution was injected into the subcutaneous fat. Fat cells were destroyed by ND: YAG laser radiation with wavelength of 1064 nm-16 W. The total power consumption amounted to 3500 J. In the postoperative period, the patient's wounds were bandaged using alcohol chlorhexidine and water-soluble ointments. At the same time, 7 days after the surgery the patient took broad-spectrum antibiotics and nonsteroidal anti-inflammatory drugs. The first 7 days after



Figure 6.
Patient P., female, 49 years old, with age-related changes in the lower third of the face of type III according to the Baker's classification, before and 2 years after the surgery.



Figure 7.
Patient A., female, 58 years old, with age-related changes in the lower third of the face of type IV according to the Baker's classification, before and 5 years after the surgery.

the surgery the patient used a compressive dressing round the clock and the following 21 days only at night. In the early postoperative period after the liposuction physiotherapy of the liposuction areas was performed in the form of 12 ultrasound procedures with hydrocortisone and 12 ultrasound procedures with a drug based on the collagenolytic protease complex “Fermencol gel”, lymphatic massage – 10 procedures. As a result of combined liposuction performed according to the said method, 75 ml of fat detritus was removed at a single stage. The control examination 5 years after the surgery demonstrated that the esthetic effect is preserved (**Figure 7**).

4. Discussion

After surgery, all patients had been discharged to outpatient after-treatment and returned to active social life in 7 days. Among postoperative complications, in 15% of cases the formation of small infiltrates up to 3 cm² in the submental area at the subcutaneous fat level must be noted. However, they successfully responded to 4 weeks of treatment with medication and physiotherapy. In addition, there was III A degree skin burn with a diameter up to 1 cm in 2 (0.4%) cases, which ended in full-fledged epithelization within 1 month.

All clinical observations achieved good esthetic results. Control examinations conducted after 3 to 48 months demonstrate the persistence of the achieved effect.

Apfelberg first demonstrated the advantage of laser-assisted liposuction over tumescent liposuction in 1992, which involved reduction of pain syndrome, hematomas and edema of the surrounding tissues [17]. In 2006 by a magnetic resonance imaging examination carried out before and 3 months after this surgery Kim showed overt and significant reduction of adipose tissue in the submental area [18]. Mordon and co-authors calculated the amount of energy applied to adipose tissue to obtain the maximum effect with subsequent derma retraction, which usually is min. 3000 J of energy spent on 5 cm³ [19]. Gain and his co-authors analyzed more than 300 sources in Russian and foreign scientific literature concerning laser lipolysis and the conclusion of this work is the proven effectiveness and safety of this surgery, as well as the continuing research interest in the effects of lasers on adipose tissue [20].

The main advantage of the Nd:YAG laser is skin retraction due to the formation of new collagen, reduction of intra- and postoperative hemorrhage, as well as reduction of the number of adipocytes. The surgeries that we have already performed and the developed algorithm demonstrate the best esthetic results over a long observation period (about 8 years), allowing us to solve esthetic problems of the lower third of face, submental area, neck, associated with not only excess

fat deposit, but also gravitational ptosis. That being said, this approach provides an opportunity to reduce the recovery period. Positive results were achieved in all age groups under the different types of ptosis. In cases of I, II and III type of ptosis of soft tissues according to Baker's classification, we achieve proper correction of the lower third of the face with laser-assisted liposuction. In cases of patients with IV type of ptosis according to Baker's classification, this surgery allows for reverting involutional changes to I type.

5. Conclusion

Consequently, based on our experience it is safe to say that laser lipolysis is one of the most suitable methods of controlling various types of aging of the lower third of the face. The surgery is minimally invasive and does not require a long recovery period. This surgery can be used as a stand-alone method as well as in combination with the implantation of threads and with various face lifting methods, thus significantly improving the esthetic effect.

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